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Title: Environmental Soil Screening Levels for Cs-137 at University of Washington Medical Center

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Environmental Soil Screening Levels for Cs-137 at University of Washington Medical Center

8-30-2019 (LA-UR-19-28234)

Jeffrey Whicker, Christine Bullock and Mary Jo Chastenet

Summary:

Current radiological surveys (exposure rate measurements and smear surveys) conducted outside the University of Washington (UW) Harborview Research and Training building found no evidence of Cs-137 contamination in public walk ways, or open areas, and preliminary soil concentrations from samples upwind and downwind of the building were within global fallout levels found in the region. Additional soil and outdoor surface sampling is being considered to more fully assess the possibility of an environmental release during the incident and the radiological impact, if any. This analysis is designed to assist in the evaluation of soil sample results and provide radiation dose-based Soil Screening Levels (SSLs) to help develop sampling and analysis plans and for evaluating these measurements in the context of radiation dose limits.

Soil samples could be used to answer two general questions. The first asks if any detected Cs-137 in the soil is above global fallout levels measured in the area. Calculations based on fallout levels from Beck and Bennett (2002)¹ and NCRP 154² suggest that current global fallout levels in Seattle area soil would range up to about 3 pCi/g in undisturbed soils, but there would be large variations based on a variety of transport factors related to the urban environment surrounding the area. Based on the sample result, any measurement significantly above background could prompt additional analysis including looking at the ratio of the Cs-137 to Pu-239/240 to help identify the source of the Cs-137, that is, from global fallout or from the incident. The second question is if there is detectable Cs-137 in the soil, what is the radiological impact of the Cs-137? For this, a dose pathway analysis using the RESRAD model was done to protectively estimate soil-based dose conversion factors and SSLs for Cs-137 in soil.

Expectations for Cs-137 in background soil

Above-ground testing of nuclear weapons from the 1940's until the early 1960's injected substantial amounts of radionuclides into the atmosphere where they eventually settled down onto earth surfaces as fallout. Cs-137 is one of the fallout radionuclides produced in enough quantity and with a sufficiently long half-life to be commonly detected in soils. Beck and Bennett (2002) showed that Seattle may have received higher amounts of the fallout due to the high precipitation rate in the city because rainfall efficiently "washes out" the atmospheric dust. The amount of this fallout, decay corrected to today, could be as much as 5.4×10^4 pCi m⁻² (2000 Bq m⁻²). However, Cs-137 fallout in urban environments washes away relatively quickly during

¹ Beck HL, Bennett BG. Historical overview of atmospheric nuclear weapons testing and estimates of fallout in the continental United States. *Health Physics* 82:591-608; 2002.

² National Council of Radiation Protection and Measurements (NCRP), Cs-137 in the environment: Radioecology and approaches to assessment and management. NCRP Report 154; 2007.

rainfall events especially from hard surfaces such as road and building surfaces, so any fallout Cs-137 remaining in the area would be most likely found in the soils.

Figure 1 is an aerial view of the University of Washington Medical complex and shows a mixture of buildings, roads, and a few places that consist of vegetation. Like the fallout radionuclides, Cs-137 released during the May event, if any, could remain in downwind vegetation and soil.

Figure 1. Aerial view of the UW Medical Center and surrounding neighborhood (google earth).



Dose-based evaluation of soil concentrations

Dose Conversion Factors that are normalized to soil concentrations of radionuclides in soil (DCF_{soil}) allow estimates of radiation dose based on levels of residual radionuclides in soils and are used to establish *SSLs*. Specifically for this case, concentrations of Cs-137 in soil can be directly correlated to a radiation dose. The dose assessment model RESidual RADionuclides

(RESRAD)³ version 7.2 was used to determine the DCF_{soil} , if Cs-137 from the accidental release was measured in nearby soils.

$$\text{Dose} \left(\frac{\text{mrem}}{\text{yr}} \right) = \text{Concentration}_{soil} \left(\frac{\text{pCi}}{\text{g}} \right) \times DCF_{soil} \left(\frac{\text{mrem-g}}{\text{pCi-yr}} \right) \quad \text{Eqn. 1}$$

From the DCF_{soil} , the SSL is calculated as:

$$SSL = \frac{\text{Dose Limit}}{DCF_{soil}} \quad \text{Eqn. 2}$$

The calculation of the DCF_{soil} requires a number of assumptions for both the characteristics and lifestyle of the receptor as well as the environmental distribution and transport of the radionuclide. Realistic but protective values were chosen for the model parameters to ensure dose was not underestimated (selected values and justification in Appendix 1). In this case, the chosen receptor was an adult residing near the UW medical complex. This resident had a home garden that grew vegetables and fruit that they consumed through the year. We assumed the resident consumed drinking water, fish and meat from uncontaminated offsite sources. Also we assumed that the resident spent 50% of the time inside their residence, 25% outside the house and 25% time outside the neighborhood. Other parameter values were the default values used in RESRAD, though rainfall and wind conditions were matched to Seattle.

Sensitivity Analysis

Because the DCF_{soil} result depends on the selected value for each model parameter, a sensitivity analysis was performed to identify parameters that had a relatively high influence on the DCF_{soil} result (Appendix 3). In this case, where external radiation pathway dominated (>75% external radiation), DCF_{soil} results were most sensitive to parameters associated with external dose rates. The rest of the potential dose would be through plant ingestion. The inhalation pathway contributed negligible dose. The sensitivity analysis is provided in Appendix 3.

For predicting external dose, the sensitive parameters included area of contamination, depth of the contaminated zone, and time spent in the area (Appendix 3). For ingestion, the plant root depth in the contaminated soil was a sensitive parameter and was selected to maximize root uptake. Based on the sensitivity analysis, protective values for area of contamination (10,000 m²), depth of the contamination (2 cm) and root depth (2 cm) were chosen. In the reality of the urban environment, this surface contamination would include both hard surfaces and smaller areas of soil. Given that we modeled surface contamination, this is a conservative assumption. The default values for the amount of time a person was in the area (inside and outside) were used because these values were thought to be reasonably protective. Soil erosion rates and parameters for downward migration into the soil were set to zero to maximize external dose rates. Doses

³ Yu C, et al. User's manual for RESRAD Version 6. Argonne National Laboratory document ANL/EAD-4; 2001.

were calculated out to 30 years, but were highest the first year. Dose for a child receptor was also analyzed but the difference in the *SSL* was minimal.

Results

Dose rate from surface deposition (soil or hard surfaces) is the main driver for dose. Assuming no washing off of the contamination, the RESRAD derived dose conversion is roughly 1 mrem/yr per 1.37 pCi g^{-1} (0.051 Bq g^{-1}), or at 100 mrem yr^{-1} (DOE, EPA, NRC public dose limit), this DCF_{soil} translates to a *SSL* of 137 pCi g^{-1} or 5.1 Bq g^{-1} (Appendix 2). For a 25 mrem yr^{-1} dose limit, the *SSL* would be 34 pCi g^{-1} (1.3 Bq g^{-1}).

Conclusions

An environmental *SSL* for residual Cs-137 in the surrounding soil was determined using RESRAD based on the agreed 25 mrem yr^{-1} dose limit criteria for this site (34 pCi g^{-1}). There are few locations in the surrounding environment that contain soil (an exception could be the building complex to the southeast of the release location and a few other grassy areas to the west). Given the unlikelihood for soil contamination levels in these areas to approach the *SSL*, it is reasonable to first do a limited set of exploratory measurements. If significant contamination is found, a more rigorous and thorough sampling can be done.

APPENDIX 1

SELECTED PARAMETER VALUES FOR THE RESRAD MODEL WITH JUSTIFICATION

SELECTED PARAMETER VALUES

RESRAD Data Field	Parameter	Units	Values	Rationale
Soil Concentration	Distribution coefficients	cm ³ /g	Default values	RESRAD default values
	Radiation dose limit	mrem/yr	25	100 mrem/yr is DOE Order 458.1; EPA; NRC public dose limit. Wash. DOH selected 25 mrem/yr dose criteria
Contaminated Zone (CZ)	Area of CZ	m ²	10,000	RESRAD default: protectively assumes an area is effectively infinite for ingestion and external irradiation exposure pathways
	Thickness of CZ	m	0.02	Contamination extends to 2 cm- Conservative assumption based on sensitivity analysis. Unlikely to extend to greater depths.
Cover and CZ Hydrological Data	Cover depth	m	0	Assumes site is contaminated at ground surface with no cover to maximize external exposure
	Density of CZ	g/cm ³	1.5	RESRAD default
	CZ erosion rate	m/yr	0	Results in constant depth of contamination over time; protectively assumes contamination is not lost by erosion
	CZ Total porosity	unitless	0.4	RESRAD Default
	CZ Field capacity	unitless	0.2	RESRAD default
	CZ Hydraulic conductivity	m/yr	10	RESRAD default
	CZ "b" parameter	unitless	5.3	RESRAD default
	Humidity in air	g/m ³	Not used	RESRAD default
	Evapotranspiration coefficient	unitless	0.999	Maximum allowed value: results in effectively no water infiltration through CZ; assumption maximizes potential dose by soil exposure over time
	Wind speed	m/s	4	Based on upper-bound wind speed in Seattle

RESRAD Data Field	Parameter	Units	Values	Rationale
Cover and CZ Hydrological Data (continued)	Precipitation	m/yr	1	RESRAD Default- Similar to Seattle annual rainfall amount.
	Irrigation	m/yr	0	No irrigation- clean city water and rainfall only
	Runoff coefficient	unitless	0.9	High value minimizes water infiltration; consistent with evapotranspiration coefficient of 0.999; assumption maximizes potential dose via external exposure
	Watershed area for nearby stream or pond	m^2	1×10^6	RESRAD default
Cover and CZ Hydrological Data (continued)	Accuracy for water/soil computations	unitless	0.001	RESRAD default
Saturated Zone Hydrologic Data	Values of all parameters set to RESRAD defaults: the drinking water exposure pathway is inactive and use of irrigation water is not specified.			
Uncontaminated Unsaturated Zone Data	Number of unsaturated strata below CZ	unitless	1	Simplified hydrology—effectively no water infiltration
Occupancy	Thickness of unsaturated strata	m	4	RESRAD default
	Soil density	g/cm^3	1.5	RESRAD default
	Total porosity	unitless	0.4	RESRAD default
	Effective porosity	unitless	0.2	RESRAD default
	Field capacity	unitless	0.2	RESRAD default
	Hydraulic conductivity	m/yr	100	RESRAD default
	Hydraulic gradient	m/yr	0.02	RESRAD default
	Well pumping rate	m^3/yr	0	Assume use of city water and rain
	Soil-specific "b" parameter	unitless	5.3	RESRAD default
	Indoor dust filtration factor	unitless	1	Protectively assumes indoor dust radionuclide concentrations equal to ambient soil concentrations
	External gamma shielding factor	unitless	0.7	RESRAD default (conservative for low to moderate energy gamma emitters, but reasonable for Cs-137)
	Indoor time fraction	unitless	0.5	RESRAD default
	Outdoor time fraction	unitless	0.25	RESRAD default
	Inhalation rate	m^3/yr	8400	RESRAD default
	Mass loading air	g/m^3	0.0001	RESRAD default
	Exposure duration	yr	30	RESRAD default
	Shape factor	unitless	1	Assumes a circular contamination zone
	Leafy vegetable consumption	kg/yr	14	RESRAD default- Assume grown on site

RESRAD Data Field	Parameter	Units	Values	Rationale
Ingestion Pathway: Dietary Data	Fruit, vegetables, grain consumption	kg/yr	160	RESRAD default- Assume grown on site
	Irrigation water contaminated fraction	unitless	0	No contribution to plant contamination from irrigation
	Soil Ingestion	g/yr	36.5	RESRAD default
	Plant food contaminated fraction	unitless	1	Produce ingestion rates specified as home grown exclusively
	Depth of soil mixing Layer	m	0.15	RESRAD default
	Depth of roots	m	0.02	Assume roots only occupy contaminated zone to maximize plant uptake
	Mass loading for foliar deposition	g/m ³	0.001	RESRAD default
Ingestion Pathway: Nondietary Data	Depth of soil mixing layer	m	0.15	RESRAD default
	Plant factors	unitless	Default values	RESRAD default
Storage Times	Fruits, nonleafy vegetables, and grain	d	1	Protectively assumes that homegrown garden produce is eaten soon after harvesting

APPENDIX 2

RESRAD MODEL OUTPUT

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Time = 3.000E+00	11
Time = 1.000E+01	12
Time = 3.000E+01	13
Time = 1.000E+02	14
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Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Dose Conversion Factor (and Related) Parameter Summary

Dose Library: ICRP 72 (Adult)

Menu	Parameter	Current	Base	Parameter
		Value#	Case*	Name
A-1	DCF's for external ground radiation, (mrem/yr) / (pCi/g)			
A-1	Ba-137m (Source: ICRP 60)	3.383E+00	3.383E+00	DCF1(1)
A-1	Cs-137 (Source: ICRP 60)	8.372E-04	8.372E-04	DCF1(2)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	1.443E-04	1.443E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	4.810E-05	4.810E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg) / (pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L) / (pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See EFTG table in Ground Pathway of Detailed Report.

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Site-Specific Parameter Summary

Menu	Parameter	User		Used by RESRAD	Parameter
		Input	Default	(If different from user input)	Name
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm***3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm***3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m***3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.900E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	9.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm***3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m***3/yr)	0.000E+00	2.500E+02	---	UW

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User		Used by RESRAD	Parameter
		Input	Default	(If different from user input)	Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.246E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User		Used by RESRAD	Parameter
		Input	Default	(If different from user input)	Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	2.000E-02	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User		Used by RESRAD	Parameter
		Input	Default	(If different from user input)	Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days) :				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec) :				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User		Used by RESRAD	Parameter Name
		Input	Default	(If different from user input)	
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	1.000E+00
Thickness:	0.02 meters		
Cover Depth:	0.00 meters		
<hr/>			
Total Dose TDOSE(t), mrem/yr			
Basic Radiation Dose Limit = 2.500E+01 mrem/yr			
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)			
<hr/>			
t (years):	0.000E+00	1.000E+00	3.000E+00
TDOSE(t):	7.277E-01	7.111E-01	6.790E-01
M(t):	2.911E-02	2.844E-02	2.716E-02
	1.000E+01	3.000E+01	1.000E+02
	5.775E-01	3.638E-01	7.214E-02
	1.455E-02	2.886E-03	2.836E-05
	1.000E+03	3.000E+02	2.670E-12

Maximum TDOSE(t): 7.277E-01 mrem/yr at t = 0.000E+00 years

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.621E-01	0.7724	1.101E-06	0.0000	0.000E+00	0.0000	1.655E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.736E-04	0.0002
Total	5.621E-01	0.7724	1.101E-06	0.0000	0.000E+00	0.0000	1.655E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.736E-04	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	7.277E-01	1.0000										
Total	0.000E+00	0.0000	7.277E-01	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.492E-01	0.7724	1.076E-06	0.0000	0.000E+00	0.0000	1.617E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.696E-04	0.0002
Total	5.492E-01	0.7724	1.076E-06	0.0000	0.000E+00	0.0000	1.617E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.696E-04	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	7.111E-01	1.0000										
Total	0.000E+00	0.0000	7.111E-01	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.244E-01	0.7724	1.027E-06	0.0000	0.000E+00	0.0000	1.544E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.619E-04	0.0002
Total	5.244E-01	0.7724	1.027E-06	0.0000	0.000E+00	0.0000	1.544E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.619E-04	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	6.790E-01	1.0000										
Total	0.000E+00	0.0000	6.790E-01	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	4.461E-01	0.7724	8.739E-07	0.0000	0.000E+00	0.0000	1.313E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.377E-04	0.0002
Total	4.461E-01	0.7724	8.739E-07	0.0000	0.000E+00	0.0000	1.313E-01	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.377E-04	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	5.775E-01	1.0000										
Total	0.000E+00	0.0000	5.775E-01	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	2.810E-01	0.7724	5.504E-07	0.0000	0.000E+00	0.0000	8.272E-02	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	8.676E-05	0.0002
Total	2.810E-01	0.7724	5.504E-07	0.0000	0.000E+00	0.0000	8.272E-02	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	8.676E-05	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	3.638E-01	1.0000										
Total	0.000E+00	0.0000	3.638E-01	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.572E-02	0.7724	1.092E-07	0.0000	0.000E+00	0.0000	1.640E-02	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.721E-05	0.0002
Total	5.572E-02	0.7724	1.092E-07	0.0000	0.000E+00	0.0000	1.640E-02	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.721E-05	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	7.214E-02	1.0000										
Total	0.000E+00	0.0000	7.214E-02	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.477E-04	0.7724	1.073E-09	0.0000	0.000E+00	0.0000	1.612E-04	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.691E-07	0.0002
Total	5.477E-04	0.7724	1.073E-09	0.0000	0.000E+00	0.0000	1.612E-04	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.691E-07	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	7.091E-04	1.0000										
Total	0.000E+00	0.0000	7.091E-04	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.156E-11	0.7724	1.010E-16	0.0000	0.000E+00	0.0000	1.518E-11	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.592E-14	0.0002
Total	5.156E-11	0.7724	1.010E-16	0.0000	0.000E+00	0.0000	1.518E-11	0.2274	0.000E+00	0.0000	0.000E+00	0.0000	1.592E-14	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.										
Cs-137	0.000E+00	0.0000	6.675E-11	1.0000										
Total	0.000E+00	0.0000	6.675E-11	1.0000										

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Thread	DSR(j,t) At Time in Years (mrem/yr) / (pCi/g)							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	7.277E-01	7.111E-01	6.790E-01	5.775E-01	3.638E-01	7.214E-02	7.091E-04	6.675E-11

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide

Nuclide	(i)	t = 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137		3.435E+01	3.516E+01	3.682E+01	4.329E+01	6.872E+01	3.465E+02	3.526E+04	3.745E+11

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr) / (pCi/g)

and Single Radionuclide Soil Guidelines G(i,t) in pCi/g

at tmin = time of minimum single radionuclide soil guideline

and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide	Initial	tmin	DSR(i,tmin)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
(i)	(pCi/g)	(years)		(pCi/g)		(pCi/g)
Cs-137	1.000E+00	0.000E+00	7.277E-01	3.435E+01	7.277E-01	3.435E+01

Summary : RESRAD Default Parameters

File : C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD

Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	DOSE(j,t), mrem/yr							
(j)	(i)		t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	7.277E-01	7.111E-01	6.790E-01	5.775E-01	3.638E-01	7.214E-02	7.091E-04	6.675E-11

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	S(j,t), pCi/g							
(j)	(i)		t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.000E+00	9.772E-01	9.330E-01	7.936E-01	4.999E-01	9.914E-02	9.744E-04	9.173E-11

THF(i) is the thread fraction of the parent nuclide.

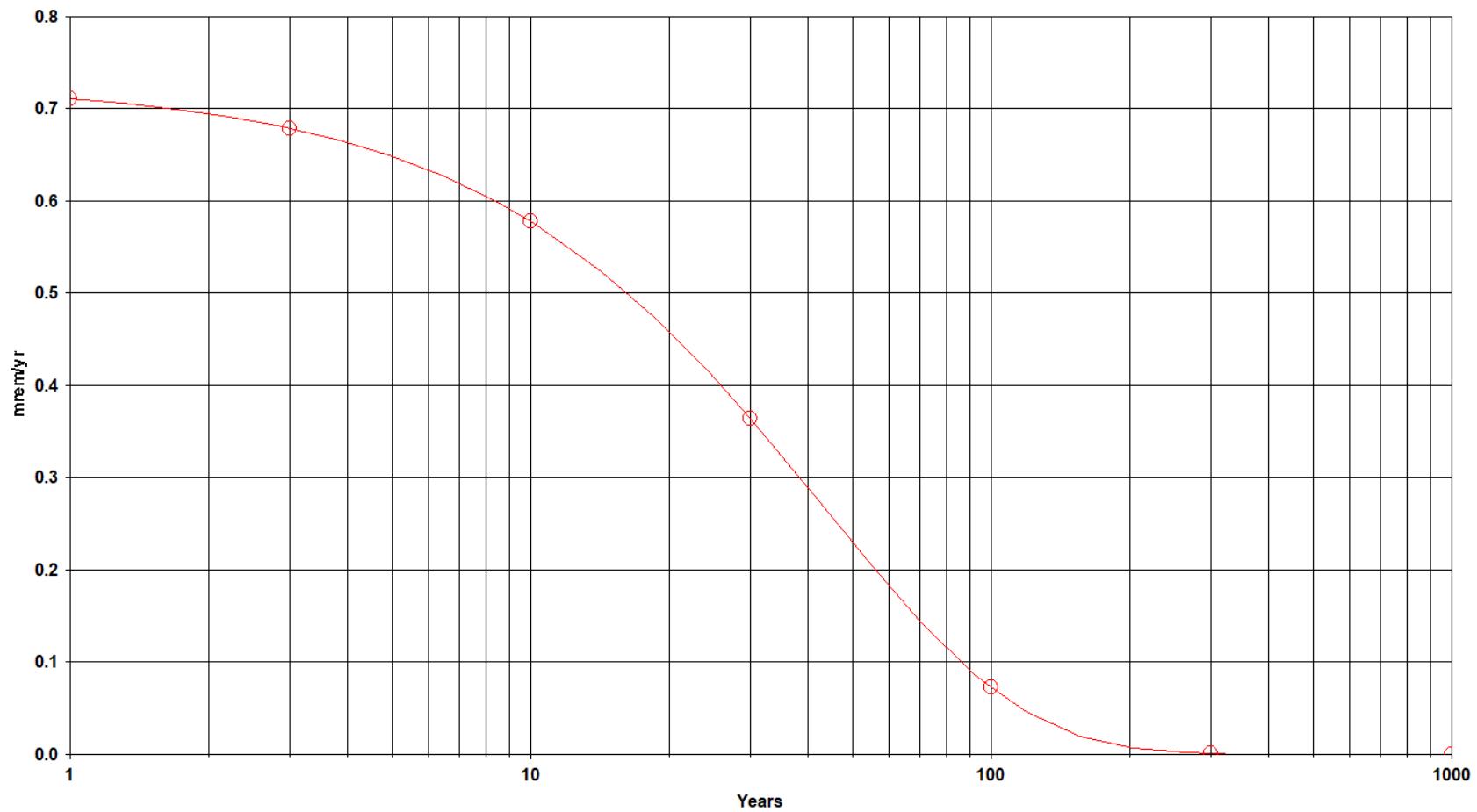
RESCALC.EXE execution time = 5.86 seconds

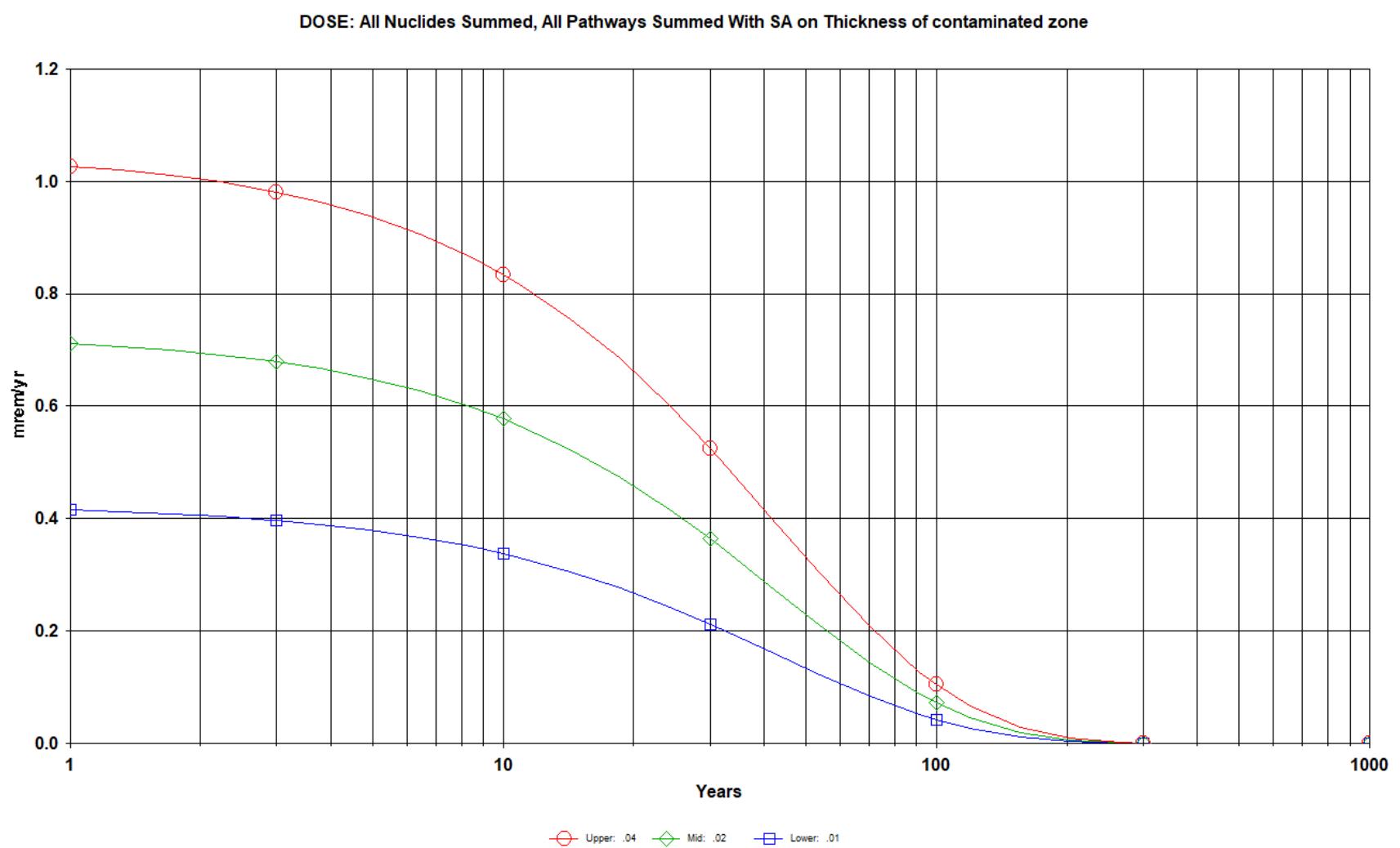
APPENDIX 3

SENSITIVITY ANALYSIS FOR RESRAD PARAMETERS

Sensitivity Analysis

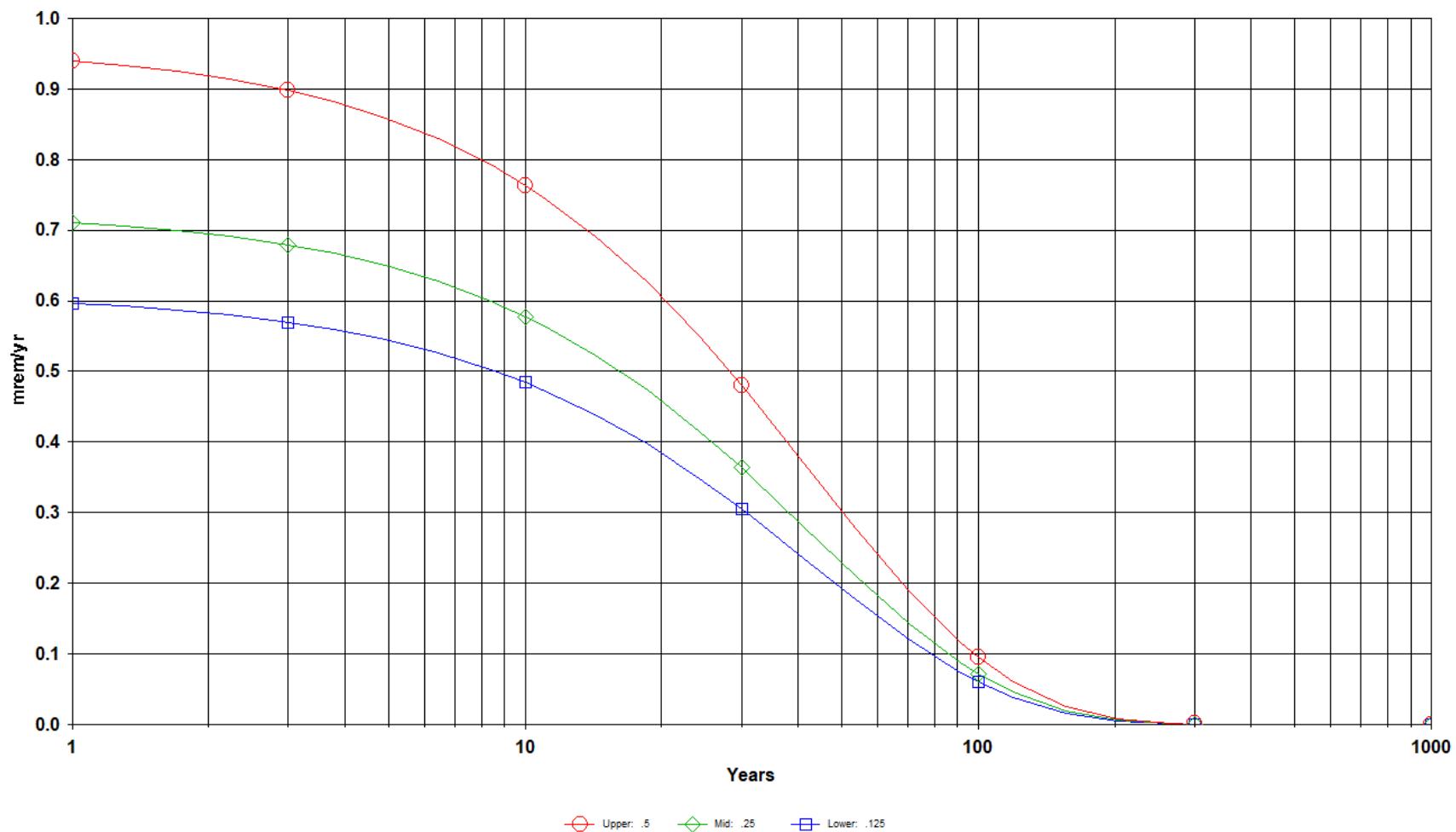
DOSE: All Nuclides Summed, All Pathways Summed





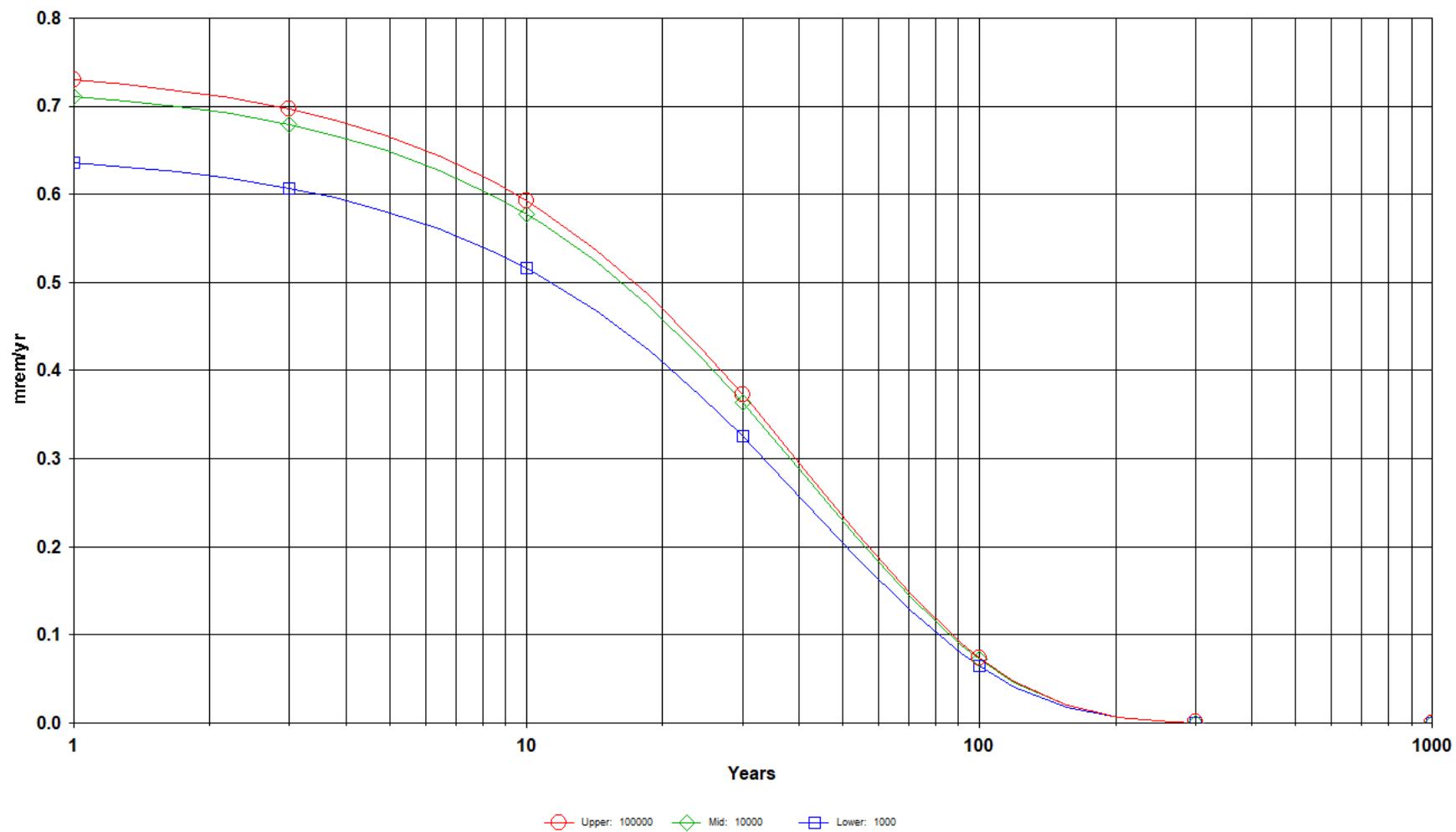
C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CSIUW_CS_R2.RAD 08/21/2019 14:36 GRAPHICS.ASC Includes All Pathways

DOSE: All Nuclides Summed, All Pathways Summed With SA on Outdoor Time fraction



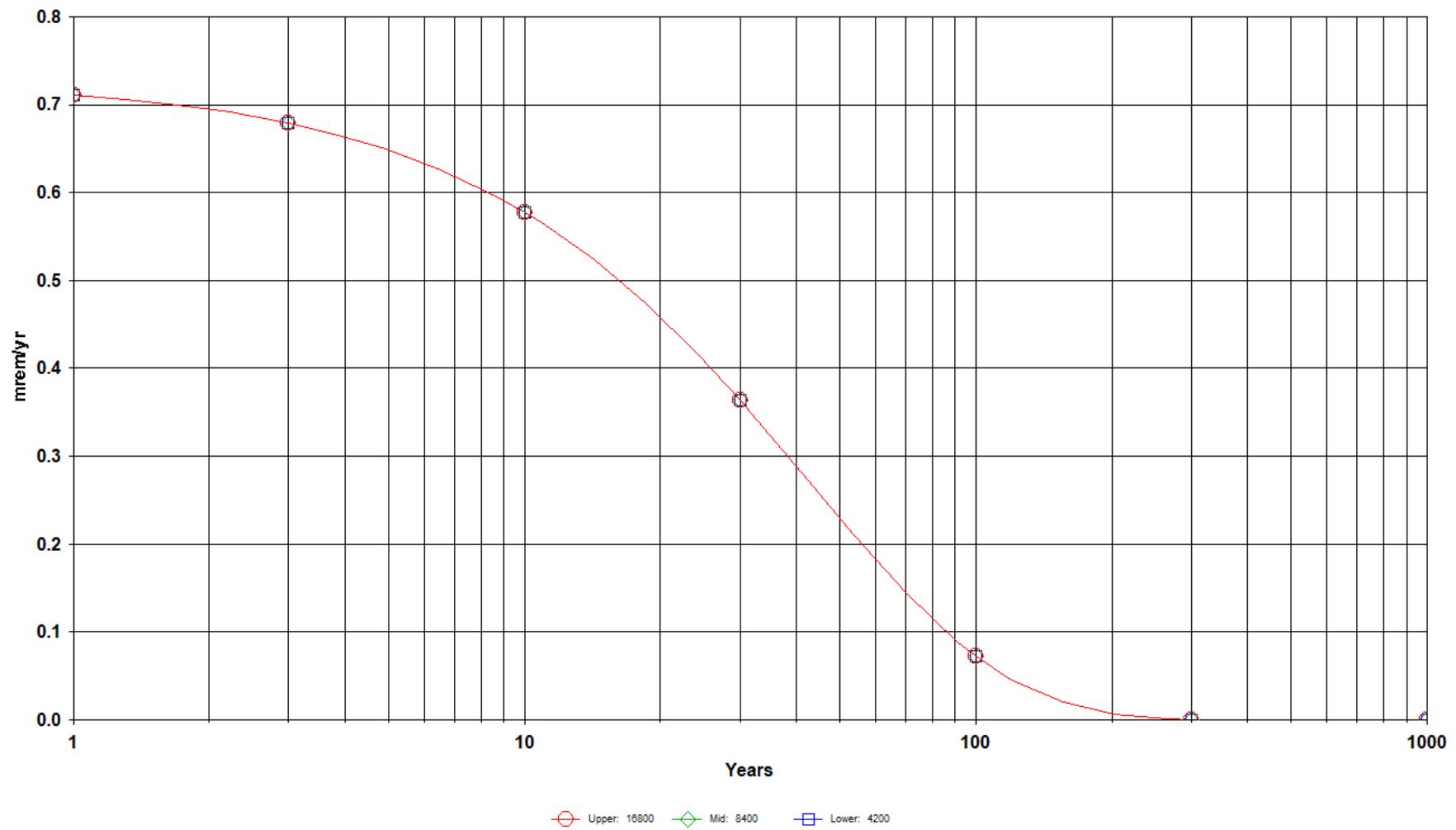
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DOSE: All Nuclides Summed, All Pathways Summed With SA on Area of contaminated zone



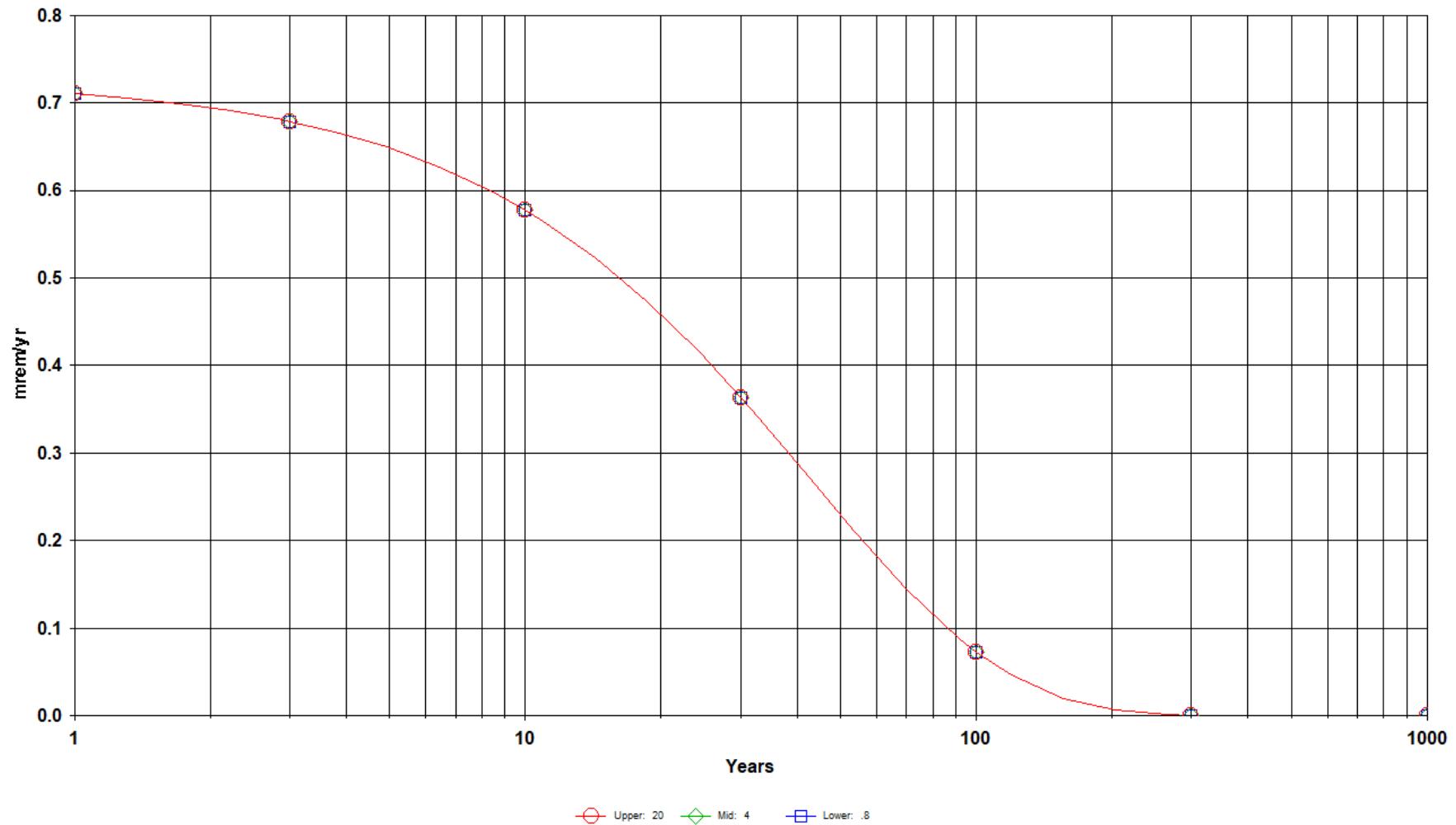
C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CSIUW_CS_R2.RAD 08/21/2019 14:36 GRAPHICS.ASC Includes All Pathways

DOSE: All Nuclides Summed, All Pathways Summed With SA on Inhalation rate



C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CS\UW_CS_R2.RAD 08/21/2019 14:36 GRAPHICS.ASC Includes All Pathways

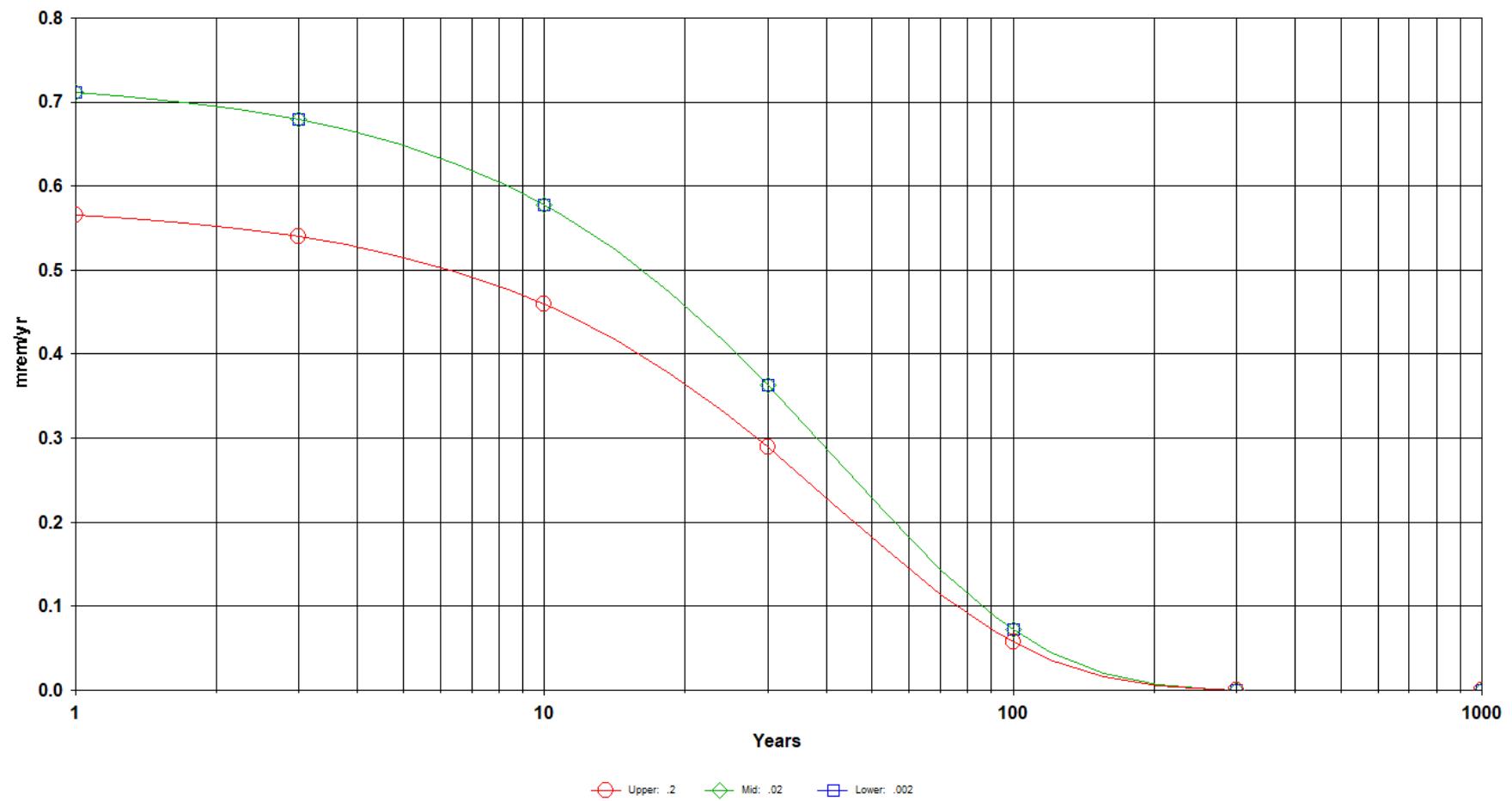
DOSE: All Nuclides Summed, All Pathways Summed With SA on Average annual wind speed



Upper: 20 Mid: 4 Lower: .8

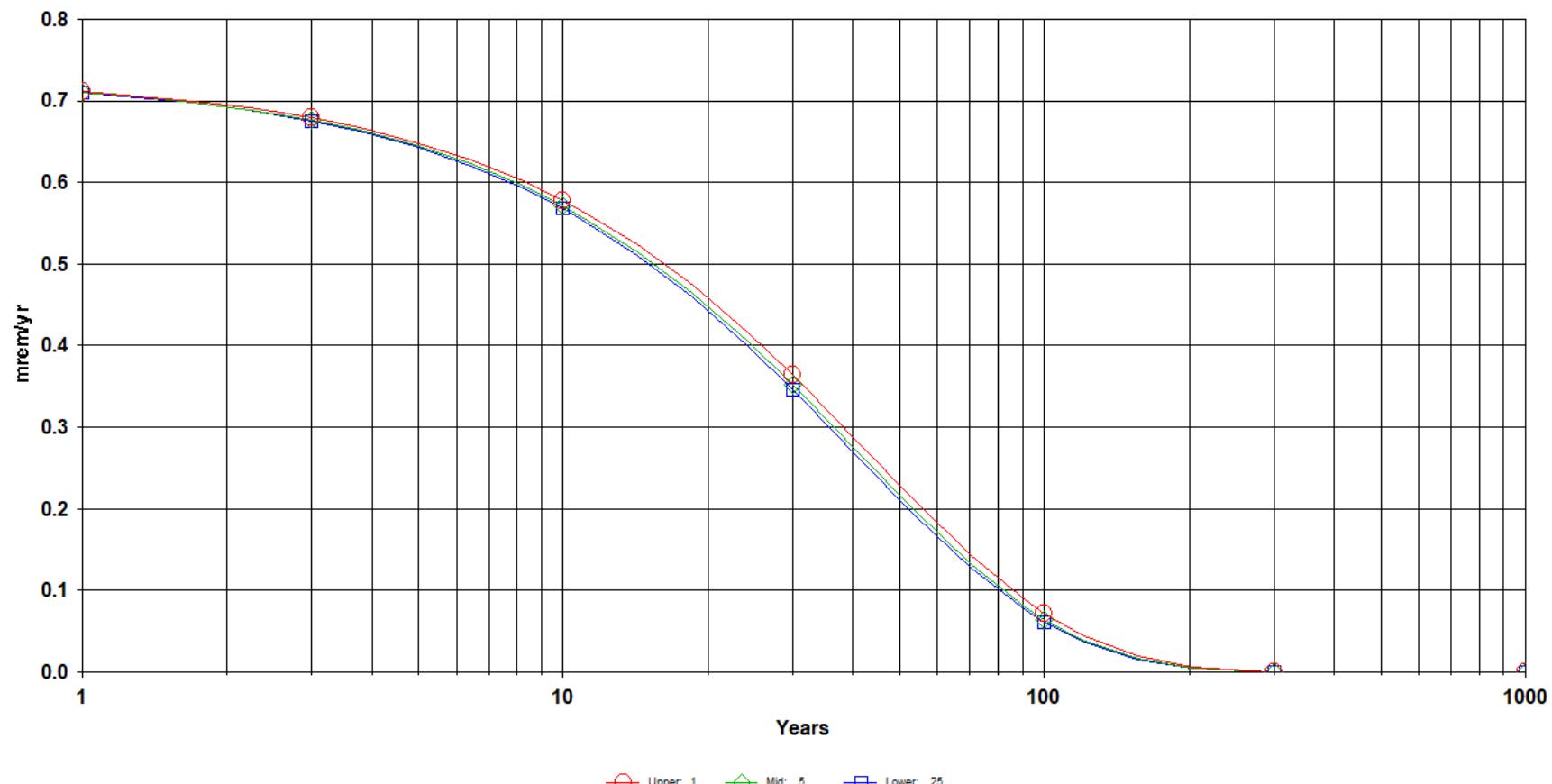
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DOSE: All Nuclides Summed, All Pathways Summed With SA on Depth of roots



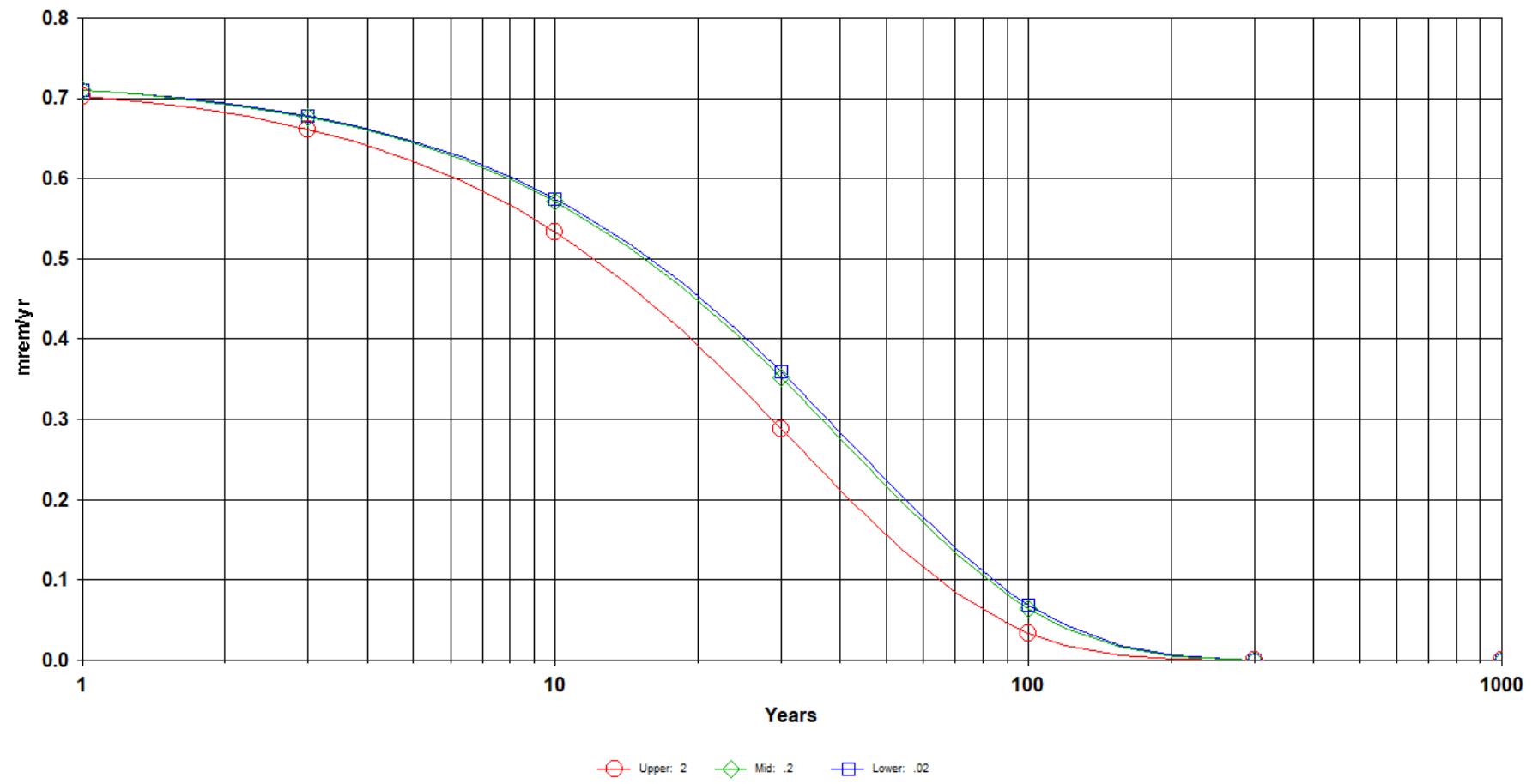
C:\RESRAD_FAMILY\ONSITE\7.2\USERFILES\UW_CSIUW_CS_R2.RAD 08/21/2019 14:47 GRAPHICS.ASC Includes All Pathways

DOSE: All Nuclides Summed, All Pathways Summed With SA on Evapotranspiration coefficient



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DOSE: All Nuclides Summed, All Pathways Summed With SA on Irrigation



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